MAJ A VALLES AND THE CHRYSE OUTFLOW COMPLEX
SITES. J. W. Rice, Department of Geography, Arizona State University, Tempe AZ 85287, USA.

Maja Valles Region: This candidate landing site is located at 19°N, 53.5°W near the mouth of a major outflow channel, Maja Valles, and two “valley network” channel systems, Maumee and Vedra Valles. This region has been mapped in detail by Rice and De Hon and is in press as a USGS 1:500,000 scale geologic map. The advantages to this site are the following: Two distinct channel forms (outflow and dendritic valley network) in one location. These channels were formed by different processes. The outflow channels are believed to have formed by catastrophic release of water and the valley networks by surface runoff and or sapping. The ideal landing site, if it could be pinpointed, would be on the fan delta complex located at the terminus of the three channels (Maja, Maumee, and Vedra Valles). The fan delta complex would be a fairly smooth surface with shallow slopes.

Water was impounded behind the wrinkle ridge system, Xanthe Scopulus, forming a temporary lake. This paleo lake bed would also present itself as a safe landing site, perhaps similar to playas. Once the wrinkle ridges were breached the water flowed northeastward in the direction of the Viking 1 lander, some 350 km away.

Objectives to be analyzed in this region are (1) origin and paleohydrology of outflow and valley network channels, (2) fan delta complex composition (this deposit located in this area is one of the few deposits identified at the mouths of any channels on the planet), and (3) analysis of any paleolake sediments (carbonates, evaporates). Another advantage to this area will be any blocks and boulders that were plucked out and carried along the 1600-km course of Maja Valles. These samples would provide a virtual grab bag of lithologies. For example, the oldest mappable rock unit (Nb, Noachian basement material) and the Hesperian ridged plains (Hr) are cut by Maja Valles before it empties into Chryse. It can be argued that we will not know their exact location, which is true, but it will provide us with information about the variety of rock types on Mars by only landing in one site. Other questions to be investigated in the area are the origin of wrinkle ridges by viewing ridge walls that were incised by the outflow, streamlined islands/bars; whether they are erosional or depositional, and if the location permits view channel wall stratigraphy, fan delta stratigraphy, and perhaps send the rover up a channel mouth near the end of its mission.

This site is below the 0-km elevation datum, with the latitude restrictions (19°N), and all the objectives stated above are within the 150-km landing error ellipse. This region is also imaged at resolutions of 40–50 m/p.

The Chryse Outflow Complex Region (Ares, Tiu, Mawrth, Simud, and Shalbatana Valles): The overall philosophy and objectives described above for the Maja Valles region apply here as well. The primary objectives here would be outflow channel dynamics (paleohydrology) of five different channel systems. One question to be answered might be whether all outflow channels are of the same origin and type. They are probably all somewhat different in terms of duration, age, source, and perhaps even origin. The grab-bag philosophy of various rock types being deposited near channel mouths would apply here also. The site is located at 15°N, 35°W. However, the longitudinal coordinate can be relaxed or slid farther to either side of 35°W. Sliding the ellipse farther to the east would allow investigations of Mawrth Valles. The region near the mouth of Mawrth Valles would be of interest because this area contains material that appears to have been dissected, thus exposing the stratigraphy of what may possibly be deltaic sediments.
Resolving power in the RBS mode is determined by the energy spread of the alpha source and the range of backscatter angles observed by the detectors. These parameters in turn determine the number of backscattered alpha particles per unit time. In the present design the use of proton and X-ray data permits us to trade selectivity for sensitivity.

The instrument has a long standing space heritage, going back to the days of Surveyors V, VI, and VII (1968–1969) and Phobos (1988). The present design is the result of an endeavor to reduce mass and power consumption (Surveyor: 10 kg/10 W; Phobos: 2.7 kg/2.5 W; this instrument: 0.6 kg/0.3 W); four instruments are scheduled to fly on the Russian Mars '94 mission: two on penetrators (without X-ray mode) and two on small stations (including the X-ray mode, using “room temperature” mercuric iodide detectors provided by the University of Chicago). These are currently being calibrated and prepared for integration.

The instrument for Mars Pathfinder will be a duplicate of the instruments for the Mars '94 small stations but with minor changes. It consists of a sensor head, incorporating the alpha sources, a telescope of silicon detectors (35 and 700 m thick) for the detection of alpha particles and protons and a mercuric iodide X-ray detector with preamplifier, and an electronics box (80 x 70 x 60 mm) containing a microcontroller-based multichannel spectrometer. The sensor head will be mounted on the rear of the Mars Pathfinder Microrover on a deployment mechanism that permits placement of the sensor in contact with sample surfaces inclined at any angle from horizontal to vertical, thus permitting measurement of the composition of soil and rock sample. The electronic box will be contained in the microrover’s “warm” container and will communicate with the microrover control system through a standard RS 232 serial interface.

To move them away from thermal influence of the lander electronics, the temperature and baseline wind sensor are mounted on the whip antenna, which communicates with the rover, about 1 m away from the lander core. The wind sensor and primary temperature sensors are about 0.5 m above the surface; two other temperature sensors are 0.25 m and 0.125 m above the surface. The second wind sensor is proposed to be mounted on the low-gain antenna, about 1 m above the surface. Pressure sensors are in the Warm Electronics Box in the lander core. The temperature profiles will differentiate between stable and convective near-surface conditions, and define atmospheric heating rate. Wind profiles will likewise discriminate stable from unstable conditions, and define near-surface shear, as well as provide a valuable input to boundary layer models.

The greatest concern we have for the descent phase results from the restriction against external deployment of the temperature sensor (for reasons of air bag safety). The sensor must sample atmosphere flowing through the lander rather than around it, at velocities well below the descent velocity. This slows sensor response time, e.g., to ~4 s if the internal velocity (yet to be established) is 1 m/s. For the entry phase, the major problem is correction of measured accelerations for angular inputs at off-center of gravity locations. For landed meteorology, the major concern is the design of the wind sensor to work sensitively at extremely low power levels in the low-density atmosphere and define wind directions. Problems of thermal contamination are also inevitably present.